minimum/maximum thermometer

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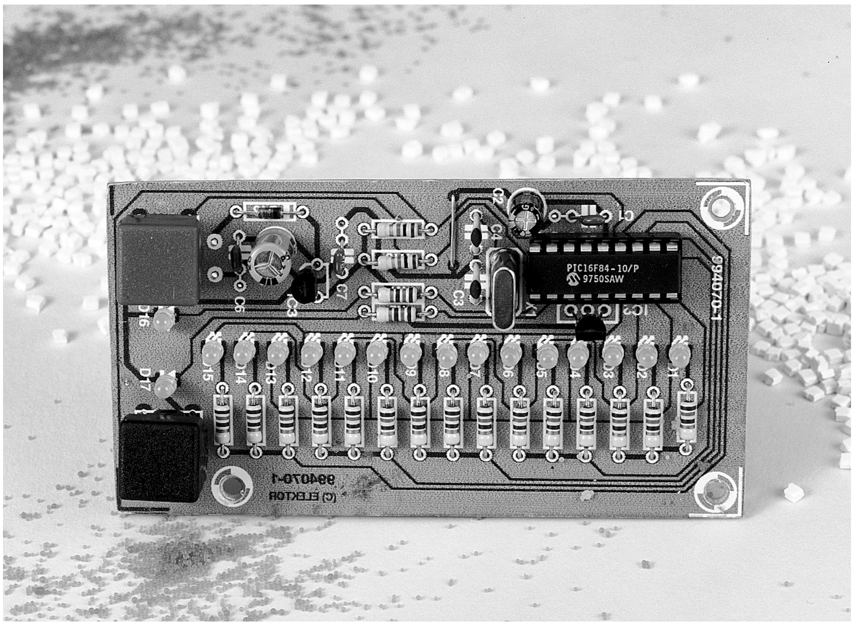

U. Reiser

Although the diagram shows a simple circuit, the thermometer is capable of measuring temperatures with a resolution of 0.5 °C over a range of 30 °C. It also shows when the temperature measured falls outside the range and retains minimum and maximum measured temperatures. All this is made possible by microcontroller IC_1, a Type PIC16F84, and assembler programme THER15. The device is available ready programmed from the publishers (Order no. 996514-1 – see Readers Services towards the end of this issue). Readers who wish to program the device themselves can obtain the source code on a diskette.

The temperature sensor is a Type SMT160, available from Smartec (www.hy-line.de/Sensor/), which does not, as is usual, output a voltage commensurate with the temperature, but a pulse-width modulated signal. This makes a separate analogue-to-digital converter unnecessary.

Only a PIC microcontroller with integral EEPROM can be used if minimum and maximum temperatures are to be retained. In the present design, a 15-way LED display, (D_1–D_{15}) is used to show temperatures in the ranges 0–15 °C and 16–30 °C. Which of these ranges is indicated by D_{16} and D_{17}. The simultaneous lighting of two adjacent LEDs indicates a half degree between their two values.

The LEDs are multiplexed in five groups of three each, so that for the display of the temperatures only one port is needed. The change from one temperature to the next takes place at a frequency of 67 Hz. When a temperature below the range is measured, only D_2 lights; when the temperature is above the range, only D_1 lights.

The stored minimum and maximum temperatures are displayed by the relevant LED when push-button switches S_1 and S_2 respectively are pressed. At the same time the relevant range LED lights. The minimum and maximum values can be erased by pressing (and holding) S_1 and then S_2 or S_2 and then S_1 respectively.

The circuit draws a current of not more than 25 mA (in case four LEDs light simultaneously). A 100 mA regulator is therefore perfectly all right. Power may be obtained from a suitable 8–12 V mains adaptor, but if low-current LEDs are used, a 9 V battery may also be considered. Note that the PIC cannot be used in the SLEEP mode since this would disable the minimum and maximum temperature memories.

The construction of the thermometer on the printed-circuit board in Figure 2 is straightforward. When purchasing the LEDs, make sure that their brightnesses are uniform; their colour does not really matter and is to individual taste. It is advisable to solder them in place last when the distance between the lid of the enclosure and the board has been established (since the diodes should just protrude through the lid).

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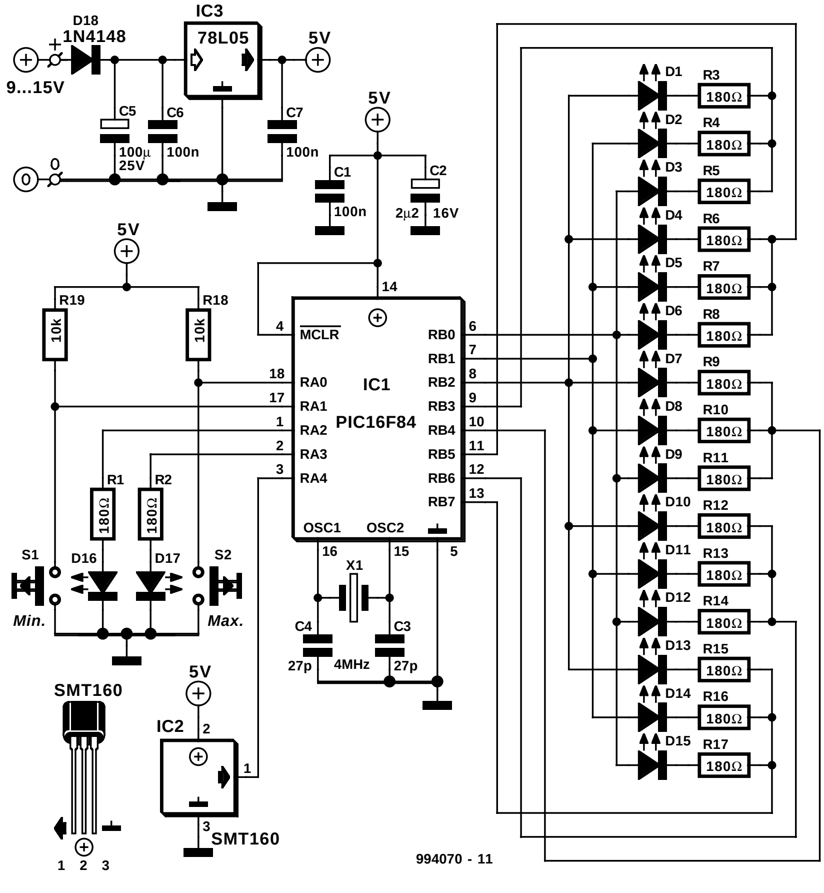

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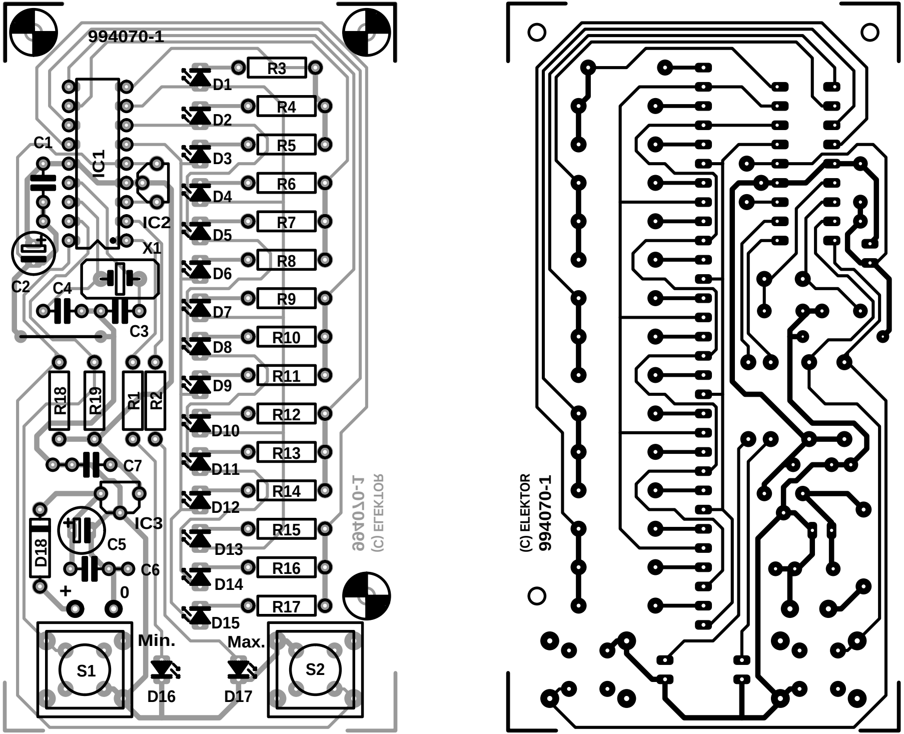

Parts list

Resistors:
R_1–R_{17} = 180 Ω (if standard LEDs are used; value should be adapted when low-current LEDs are used)
R_{18}, R_{19} = 10 kΩ

Capacitors:
C_1, C_6, C_7 = 0.1 µF
C_2 = 2.2 µF, 16 V
C_3, C_4 = 27 pF
C_5 = 100 µF, 25 V

Semiconductors:
D_1–D_{17} = LED (see text)
D_{18} = 1N4148

Integrated circuits:
IC_1 = PIC16F84-10P (ready programmed Order no. 996514-1)
IC_2 = SMT160 (Smartec)
IC_3 = 7805

Miscellaneous:
S_1, S_2 = push-button switch with make contact
X_1 = quartz crystal, 4 MHz
Diskette with source code, order code 996020-1